

Counting

Combinatorics

Definition of Probability

Equally Likely Outcomes

Axioms of Probability

Stories

Enigma Machine

Rectangles in a Grid

Serendipity

Birthday Paradox

Random Shuffles

Counting Graphs

Set Diversity

Texas Holdem Poker

🔑 Foundations Problems

📖 Part 2: Core Probability

Probability of **or**

Conditional Probability

Independence

Probability of **and**

De Morgan's Law

Law of Total Probability

Bayes' Theorem

Log Probabilities

Many Coin Flips

Stories

Bacteria Evolution

Google Rain Prediction

Random Walks

Binomail with Different Probs

	$X = 0$	$X = 1$
$Y = \text{Frosh}$	0.01	0.13
$Y = \text{Soph}$	0.05	0.33
$Y = \text{Junior}$	0.04	0.21
$Y = \text{Senior}$	0.03	0.12
$Y = 5+$	0.02	0.06

What is the probability that a student's favorite digit is 0, $P(X = 0)$? We can use the LOTP to compute this probability:

$$\begin{aligned} P(X = 0) &= \sum_y P(X = 0, Y = y) \\ &= P(X = 0, Y = \text{Frosh}) \\ &\quad + P(X = 0, Y = \text{Soph}) \\ &\quad + P(X = 0, Y = \text{Junior}) \\ &\quad + P(X = 0, Y = \text{Senior}) \\ &\quad + P(X = 0, Y = 5+) \\ &= 0.01 + 0.05 + 0.04 + 0.03 + 0.02 = 0.15 \end{aligned}$$

Marginalization with More Variables

The idea of marginalization can be extended to joint distributions with more than two random variables. Consider having three random variables X , Y , and Z , we could marginalize out any of the variables:

$$\begin{aligned} P(X = x) &= \sum_{y,z} P(X = x, Y = y, Z = z) \\ P(Y = y) &= \sum_{x,z} P(X = x, Y = y, Z = z) \\ P(Z = z) &= \sum_{x,y} P(X = x, Y = y, Z = z) \end{aligned}$$